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Engineered Facilities at Landfills that Receive Municipal and/or Non-Hazardous Waste

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MINISTRY OF ENVIRONMENT AND ENERGY

ENGINEERED FACILITIES AT LANDFILLS THAT RECEIVE MUNICIPAL AND/OR NON HAZARDOUS WASTE
PROCEDURE C-13-1

(APRIL 20, 1988 - REVISED MARCH, 1993)

This procedure addresses engineered facilities at sites receiving municipal and/or non hazardous wastes and applies to the assessment of new landfills or landfills requiring expansion. The term "facility" as used in this document refers to the entire system or the individual components of a system that is established to serve a particular purpose. For example, the term would apply to an entire leachate collection system or the pumps and pipes that may comprise that system. Although the general engineering principles on which this document is based are applicable to closed landfills or landfills requiring remedial measures for contaminant control, the document itself is not intended to address such landfills and its specific requirements may not be applicable. Engineered facilities at sites receiving hazardous wastes, as defined by Regulation 347, will be dealt with on a case-by-case basis.

Some level of engineering is necessary for all modern landfills both for the protection of the environment from the discharge of unacceptable levels of liquid and gaseous contaminants, and for aesthetic reasons. The specific engineered facilities that are required on a particular landfill depend on the environmental conditions that are present and the type of waste, and thus can only be judged on a case-by-case basis. In some cases, this may entail only simple ditching or grading for the control of surface run off, in others complex leachate and gas control facilities may be required. The scope of the term "engineered facility" is discussed in Attachment A.

Landfills must meet the requirements of Guideline B-7 entitled: "Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities", which limits groundwater contamination from waste disposal sites.

POSITION STATEMENT

It is the Ministry position that there are limitations to engineered facilities. Preferred sites for engineered facilities are those in environments with characteristics that provide a high degree of natural protection or where there is no useful or potentially useful groundwater resource. This is discussed further in Attachment B.

The acceptability of an engineered facility for a new landfill or a landfill that is expanding will be judged in accordance with the following:

> **"Any engineered landfill facility shall be designed, constructed, operated and maintained to function effectively for as long as it is required for the protection of the environment. If periodic or continuous maintenance or replacement of an engineered facility or its parts is required, evidence must be provided by the applicant that this can and will be accomplished. It is the applicant's responsibility to define the service life of an engineered facility and indicate the frequency of replacement and the number of times it must be replaced. In so doing, the applicant must address the contaminating life span (i.e. The time period during which the landfill will produce contaminants at levels that could have an unacceptable impact if they were to be discharged into the surrounding environment) of the landfill, equate this with the service life of the proposed engineered facility, and support any procedures intended to ensure that the service life of the facility exceeds the contaminating life span of the landfill". The Ministry will review and evaluate the applicant's proposal.**

Engineered facilities (or combinations of facilities) must meet the following requirements:

1. It must be possible to monitor the engineered facility to verify that it performs to specification. As monitoring facilities may be required for the Contaminating Life Span of the landfill, very long service lives or provisions for replacement may be required. Monitoring must be able to warn of failure sufficiently in advance to allow contingency measures to be taken. Contingency measures are designed to accommodate any unanticipated failure in the design or performance of a landfill and are not a part of the normal operation during the Contaminating Life Span of the facility during operation or post closure.

2. The Contaminating Life Span of the landfill must be addressed in the contexts of the service lives of the various engineered facilities that are used to control contamination. It should be noted that the Contaminating Life Span of a landfill is dependent on a number of factors, including the capacity of the environment that surrounds the landfill to attenuate the contaminants in the leachate, the characteristics of the wastes, and the design of the landfill and is therefore specific to a particular landfill

site.

3. Provision must be made for the maintenance of an engineered facility and its operation for as long as is required under the Position Statement. An application must contain a detailed outline of;

   a) how funding will be provided,
   b) who will bear the short-term and ultimate responsibility for the facility,
   c) the length of time that the facility will be operating, and,
   d) recommendations as to the conditions under which the facility can be closed down or no longer monitored or maintained.

4. Manuals on the design of various types of engineered contaminant control facilities, such as covers and liners, are available. However, some of these are very specialized and are new technologies. Under these circumstances technical supporting data (eg: case histories and reports applicable in Ontario) on the performance of these systems are required.

5. It is the responsibility of the applicant to specify the time period for the decommissioning of an engineered facility. If this is not done the Ministry will consider that the facility will be required indefinitely and provisions for its perpetual care, maintenance and replacement must be provided.

This procedure addresses synthetic membrane and earth and clay liners, leachate collection and treatment facilities, synthetic membrane and "clay" covers and rapid stabilization and leachate recycling facilities. Other types of engineered facilities (see Attachment A) will be addressed if the need arises.

LANDFILL LINERS

Synthetic Membrane Liners: To function properly, a synthetic membrane liner (also called a flexible membrane liner) must retain its integrity (i.e. function as designed) for the Contaminating Life Span of the landfill. The following factors must be taken into account in considering synthetic membrane liners.

1. Synthetic membrane liners cannot be replaced when their service lives expire.

2. Improvement in the quality of the leachate with time is not

well defined.

3. There is limited field experience with synthetic membrane liners in landfills in terms of their service lives.

4. Synthetic membrane liners may impede monitoring of landfills to provide early warning of impending failure.

Given the foregoing concerns, synthetic membrane liners will be considered on a case by case basis, taking into account the proposed/predicted Contaminating Life Span of the landfill, and the potential of the site to offer natural protection.

Earth and Clay Liners: Earth and clay liners may serve to reduce leachate discharge and confine leachate for collection and to attenuate some of the contaminants in leachate migrating out of a landfill. They may be used along or in conjunction with synthetic membrane or other types of liners. Applicants proposing to use earth or clay liners should address these matters in their submissions.

LEACHATE COLLECTION FACILITIES AND LEACHATE TREATMENT FACILITIES

To serve effectively leachate collection facilities and leachate treatment facilities must function for the Contaminating Life Span of the landfill. The state-of-the-art only allows an approximate estimate of how much the quality of the leachate in a landfill will change or improve with time. Therefore in the absence of data or site specific information on the Contaminating Life Span of the landfill, the Ministry must assume that the complete attenuation of the contaminants in the leachate is necessary, and will require that provisions be made to maintain and operate collection facilities and treatment facilities in perpetuity.

Leachate collection facilities and leachate treatment facilities must be designed, constructed, operated and monitored by professional staff and require competent technical staff for their continued maintenance, repair and replacement. Where approved, the Ministry will require that adequate resources be dedicated to the maintenance of any leachate collection, treatment, transporting and disposal facilities for as long as the leachate remains a potential hazard to the environment.

LANDFILL COVERS

Synthetic Membrane Covers: Synthetic membrane covers are used to prevent or significantly decrease infiltration into a landfill in order to reduce the rate of leachate production. This reduction of infiltration retards decomposition and extends the

Contaminating Life Span of a landfill. Consequently, this type of cover is not encouraged in situations where it would delay stabilization of the wastes. An applicant proposing such a cover must establish the Contaminating Life Span of the landfill and provide for maintenance and periodic replacement of the cover as long as required. In the absence of evidence to the contrary, this will be considered to be in perpetuity.

Synthetic membrane covers will impede the upward venting of gases, and in particular methane, and in so doing may increase the distance these gases migrate laterally. These concerns should also be addressed in submissions to the Ministry.

"Clay" Covers: Clay covers (covers incorporating fine textured earth materials) are also intended to reduce infiltration into landfills. Such covers require maintenance to ensure proper growth of vegetation and to prevent failure by erosion and fissuring. Resources for these maintenance activities should be identified by an applicant. An applicant proposing a "clay" cover, that is specifically designed for the purpose of controlling infiltration, must establish the Contaminating Life Span of the landfill and provide for maintenance and repair of the cover as long as required. In the absence of evidence to the contrary, this will be considered to be in perpetuity.

RAPID STABILIZATION AND LEACHATE RECYCLING

Rapid stabilization of a landfill is a process intended to accelerate the biodegradation of the waste and reduce the time period during which settlement is most rapid and the landfill produces its most highly contaminating leachate. Although the technology has been known for 15 to 20 years, and has been used in some operating landfills there is little documented information from practical successful operations.

While rapid stabilization will accelerate the biological degradation and leaching of a landfill it does not create a contaminant-free waste. A "stabilized" landfill still produces methane and a contaminating leachate.

Leachate recycling entails pumping the leachate produced from a landfill back into the landfill. This is the basis for most rapid stabilization operations but is also used as a means of delaying the handling and disposal of leachate by temporarily storing this leachate in the landfill. In most instances this will be a short-term measure and leachate, will eventually accumulate to a volume that exceeds the storage capacity of the landfill. Disposal must then be made in a manner acceptable to the Ministry.

Leachate recycling may create added hydraulic head on the base of the landfill and this will cause an increase in the amount of leachate discharge to the surrounding soils. It may also increase the production of landfill gas. These concerns must be addressed by an applicant in the design of a landfill.

An important aspect of this Procedure is the requirement that, if the Contaminating Life Span of the landfill is not addressed in an applicant's submission, it will be assumed that certain engineered facilities must function in perpetuity. Rapid stabilization of the landfill is the only known method of shortening this Contaminating Life Span so that contaminants released to the environment can be attenuated by natural processes. In light of the shortage of practical field data on this process, submissions should be conservative and should be supported by practical contingency measures in the event that stabilization is not as effective as predicted.

CONCLUDING STATEMENT

This procedure may restrict the use of engineered facilities as a means of landfilling in sensitive hydrogeologic environments. However, the level of control required is necessary to protect Ontario's clean environment and valuable ground and surface water resources. Where some reasonable level of natural protection is present or where practical contingency measures are possible, engineered facilities will be considered on a case by case basis.

Attachment A

SCOPE OF THE TERM ENGINEERED FACILITY

This procedure applies to all engineered facilities associated with the control of contaminants produced from landfills that receive municipal and/or non-hazardous wastes. This includes but is not restricted to, the design, installation and maintenance of:

a) Liners, or combinations of liners beneath landfills (synthetic membrane, earth, clay, etc.)

b) Landfill covers, (synthetic membrane, earth, clay, etc.)

c) Leachate collection facilities (drains, tiles, ditches, etc.)

d) Gas collection, utilization, treatment, interception and

venting facilities.

e) Monitoring facilities (for ground and surface waters and for gas)

f) Leachate treatment facilities

g) Facilities for the control of contaminated groundwater (purge wells, grout curtains, etc.)

h) Facilities for "stabilizing" a landfill or decreasing the time during which the landfill produces contaminants

Attachment B

PREFERENCE FOR NATURAL PROTECTION LANDFILL SITES

Engineered facilities are used to compensate for deficiencies in the ability of the natural environment to attenuate the contaminants produced in a landfill. However it is the Ministry position that there are limitations to engineered facilities and therefore sites in environments with characteristics that provide a high degree of natural protection or where there is no useful or potentially useful groundwater resource are preferred. This position is based on the following rationale:

a) A landfill will produce leachate that, depending on the particular environment, has the potential, for a very long time, to cause contamination. This time is almost certainly more than 50 years and could be more than 100 years. Even a landfill that has been "stabilized" will produce a leachate that may be of environmental concern. Thus, if there is a groundwater resource present that must be "protected", some natural attenuation will be required at all sites after the service lives of the engineered contaminant control facilities have expired.

b) There is, for the most part, less than 30 years of experience on the performance of engineered leachate control facilities and in particular flexible membrane liners in landfills and leachate collection systems. Although short term field and laboratory data can be extrapolated to predict the long term performance and the service lives of engineered leachate control facilities, in the absence of long term field data some uncertainty remains.

Guideline C-13 does not preclude landfills that rely on engineered leachate control facilities for environmental

protection. However, such sites should be located where monitoring and contingency measures are workable so that if the engineered leachate control facilities fail prematurely, environmental damage will be limited. Where there is reason to believe that the quality of the leachate will not be acceptable when the service life of the initial leachate control system has expired, provision must be made at the outset for successive measures to be implemented to control the leachate, and its impact at the site boundary, as necessary.